BCG
SHARED SOLUTIONS

N BUDGETING TO MEET YIELD POTENTIAL

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INTRODUCTION

Estimating your crop nitrogen requirements will assist in developing an accurate fertiliser strategy to support financial and agronomic efficiencies in production. Important components include estimating yield potential, estimating crop nitrogen requirements and matching the two.

Over the years, a range of tools have been developed to estimate yield potential including the French and Schultz equation (1984), the 2006 Sadras and Angus formula (which is the formula used in Yield Prophet Lite®) and the crop modelling product, Yield Prophet® which is available via subscription.

More recently, research conducted by Harries et al. produced an estimate (2022) based on water use (WU) calculations and factors derived from analysis of commercial crops in Western Australia to determine water limited potential yield (PY_W). It is calculated as the best yield an environment can produce with the best cultivar, best management practices and with high water use efficiency. Once calculated for your crop, it should be considered a yield benchmark to aim for.

The calculation of water limited potential yield for different crops are:

$$\text{Wheat } PY_W = (WU - 45) \times 25$$

$$\text{Barley } PY_W = (WU - 50) \times 24$$

$$\text{Canola } PY_W = (WU - 80) \times 15$$

This calculation is used in conjunction with economic yield % (EY) which allows for an adjustment to the estimate that recognises the law of diminishing returns; as inputs required to achieve high yields (ie. urea) are increased, returns decrease to the point where they become unprofitable. 80% of PY_W is generally used.

STEP 1. ESTIMATING CROP WATER USE (WU)

Crop water use (WU) has three components to calculate:

a. Calculate soil plant available water (PAW) at 1 April (prior to the start of growing season). This can be estimated from soil moisture tests, push probes and soil moisture probes or by using a factor of 25 per cent of the preceding fallow rainfall.

Rule of Thumb: If you haven't measured soil water prior to sowing, a simple rule of thumb is approximately 25 per cent of summer fallow rainfall is available to the following crop, assuming no weeds.

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b. Calculate the growing season to date if making in-season estimates. This is the rainfall since 1 April in mm.

c. Make an estimate of rainfall for the rest of the growing season (till 31 Oct in Low or Medium rainfall zones or till 30 Nov in high rainfall zones). This data can be obtained based on climate outlooks, historical records, apps such as CliMate and gut feel.

A simple formula, for calculating crop water use is:

$$WU(mm) = (0.25 \text{ X Nov-Mar rainfall}) + \text{Apr-Oct rainfall}$$

Tip: Rather than using one estimate for growing season rainfall, conduct a sensitivity analysis by selecting a range of outcomes: low, medium and high (or decile 2, 5 and 7) to calculate a range of yield outcomes for your crop.

Example for estimating yield potential: For a wheat crop growing at Beulah on 1 July.

a. Calculate soil plant available water at 1 April. Using your records or a nearby weather station.

= 0.25 X (Nov rainfall 28mm + Dec rainfall 27mm + Jan rainfall 4mm + Feb rainfall 1mm + March rainfall 5mm)

= 0.25 x 65mm

= 16.25mm

b. Calculate the growing season rainfall to date. Using your records or a nearby weather station.

= April rainfall 10mm + May rainfall 25mm + June 35mm

= 70mm

c. Estimate rainfall for the rest of the growing season (climate outlook, historical BoM records, gut feel etc)

= July rainfall 36mm + Aug rainfall 39mm + Sept rainfall 37mm + Oct rainfall 35mm

= 147mm

Continued

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Continued

WU (mm) = (16.25 + 70 + 147)

= 233mm

Wheat PY_W is calculated as (WU – 45) x 25

= (233 – 45) x 25

= 4 706 kg/ha

Wheat Economic Yield (EY) is calculated as PY_W x 0.8

= 4 706 x 0.8

3 765 kg/ha

Wheat EY = 3.8 t/ha

STEP 2: CALCULATE N REQUIREMENTS

Now that target yield has been identified, determining the amount of N required is relatively straight forward. Table 2 outlines this estimation.

Table 2. Nitrogen (N) needed to meet grain yield target

Crop	1 t/ha	2 t/ha	3 t/ha	4 t/ha	5 t/ha
Wheat	40kg N/ha	80kg N/ha	120kg N/ha	160kg N/ha	200kg N/ha
Barley	35kg N/ha	70kg N/ha	105kg N/ha	140kg N/ha	175 kg N/ha
Canola	80kg N/ha	160kg N/ha	220kg N/ha	300kg N/ha	Good luck to you!

To work out the amount of urea (kg/ha) to apply, divide the nitrogen requirement by 0.46 which is the component of N in urea.

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Example:

3.8 t/ha wheat yield potential, with a starting soil N supply of 60 kg N/ha and 7 kg N/ha applied via MAP at sowing, requires:

3.8 x 40 kg N/ha = 152 kg N/ha

152-60- 6 kg N/ha = 86kg N/ha

86 ÷ 0.46 = **186 kg urea/ha**

REVIEW DURING THE GROWING SEASON AND AFTER HARVEST

There are many reasons why a crop might not reach its yield potential, such as time of sowing, frost, heat and moisture stress. As the season progresses, climate outlooks generally become more reliable therefore, consider reviewing your yield potential throughout the growing season and especially prior to applying urea. A review after harvest, to consider any discrepancies between actual and estimated yields, is useful to identify areas for improvement in subsequent years.

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RiskWi$e – the National Risk Management Initiative

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